

‘Amsterdam is Standing on Norway’ Part II: The Global North Atlantic in the Ecological Revolution of the Long Seventeenth Century

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‘Amsterdam is standing on Norway’ – this was a popular saying in the Dutch Republic of the seventeenth century. There was more than one inflection to the phrase. Amsterdam was, in the first instance, built atop a subterranean forest of Norwegian origin. But southern Norway was also a vital resource zone, subordinated to Amsterdam-based capital. This paper follows the movement of strategic commodity frontiers within early modern Europe from the standpoint of capitalism as world-ecology, joining in dialectical unity the production of capital and the production of nature. Our geographical focus is trained upon the emergence of the Global North Atlantic, that zone providing the strategic raw materials and food supplies indispensable to the consolidation of capitalism – timber, naval stores, metals, cereals, fish and whales. I argue for a broader geographical perspective on these movements, one capable of revealing the dialectical interplay of frontiers on all sides of the Atlantic. From its command posts in Amsterdam, Dutch capital deployed American silver in the creation of successive frontiers within Europe, transforming Scandinavian and Baltic regions. The frontier character of these transformations was decisive, premised on drawing readily exploitable supplies of land and labour power into the orbit of capital. We see in northern Europe precisely what we see in the Americas – a pattern of commodity-centred environmental transformation, and thence relative ecological exhaustion, from which the only escape was renewed global conquest and ever-wider cycles of combined and uneven development.

Keywords: political ecology, environmental history, historical sociology, world-systems analysis, capitalism as world-ecology

Here geography was servant as often as master.

– C.H. Wilson (1976, 10)

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A funny thing happened after Europe's 'great depression' of the mid-sixteenth century (Elliot 1968, 56). Problems had been mounting since the 1520s. These were most evident in cash-crop agriculture and the extractive sectors, as good an index of capitalist advance as any. Central Europe's production of silver, copper and iron faltered; Madeira's sugar output had collapsed; the price of timber and other forest products from Danzig had begun to rise (Malowist 1960; Vlachovic 1963; Pereira 1969; Braudel 1982). What happened after the 1550s did not, however, follow the medieval pattern. There is no question that the 'first' sixteenth century (c. 1450–1557) was a golden age of commodification and technical advance (Nef 1964). And there is little question that this golden age *looked* a lot like earlier waves of commercial 'efflorescence' in Europe, and not only in Europe (Goldstone 2002). But something different was now in play. For all the diversity of regional variation, at a system-wide level commodification did not recede. Seigneurial hegemony over agrarian life did not advance.

As we saw in Part I, Spain's agro-ecological exhaustion, building from mid-century and achieving full flower by the 1590s, replayed in certain key respects feudalism's long fourteenth century crisis. The crucial difference was that Spain's crisis was linked up with a cascading series of commodity revolutions, driven forward by what we have called the commodity frontier. In a nutshell, the exhaustion of labouring bodies, mineral resources and ecosystems in any single region, a severe limit to previous modes of production, was now resolved through – and became a lever of – the global advance of the commodity form. As the first sixteenth century gave way to a second (1557–1648), the 'great depression' offered a magic opportunity to extend the hegemony of commodity production and exchange. The late medieval crisis had occasioned the rapid retreat of commercialization. But after 1450, and relentlessly after 1550, there would be no system-wide reversal of the trend towards the commodification of everything.

This gave rise to a world ecological revolution unprecedented in the history of humankind. By the middle of the sixteenth century, the Dutch were on their way to becoming the first great superpower of the modern era, and they were at the centre of this ecological revolution. The Dutch either pioneered directly, or were implicated in, an extraordinary wave of environmental transformations in the century or so after 1568: (1) northeastern Brazil's rise to the commanding heights of the world sugar economy, displacing São Tomé in the last three decades of the seventeenth century (Schwartz 1985); (2) the movement of the African 'slaving frontier' from the Gulf of Guinea to Angola and the Congo (Miller 1988); (3) Potosí's ascent after 1545, and its dramatic restructuring after 1571, on the heels of the exhaustion of Saxon and Bohemian silver mining (Moore 2010); (4) in South-East Asia, the destruction of clove trees, nutmeg and mace, casualties in the Dutch East India Company's battle to control the lucrative spice trade in the opening decades of the seventeenth century (Boxer 1965); (5) the draining of the fens in England, and of wetlands across the Atlantic world, from Pernambuco to Warsaw, from to Rome to Göteborg (Wilson 1968, 78–81; Rogers 2005, 51); (6) the relocation of Spanish shipbuilding to Cuba, where one-third of the fleet was built by 1700 (Parry 1966); (7) the movement of the forest products frontier from Poland and Lithuania to southern Norway in the 1570s, followed by renewed movements into the hinterlands of Danzig (again), Königsberg, Riga and Viborg; (8) the rise of

the Vistula breadbasket in the 1550s; (9) the re-centering of European copper and iron production in Sweden, beginning in the late sixteenth century, displacing Hungarian and German centres; and (10) the ever more expansive forays of the herring, cod and whaling fleets across the breadth of the Global North Atlantic.

If all these movements were interconnected, they were not all created equal. The North Atlantic moment of this world ecological revolution was crucial: Scandinavian and Baltic forest products, Polish grain, Swedish metals, Atlantic fishing and whaling. Without the bread and fish, iron and copper, and timber and forest products won from these commodity frontiers, the re-centering of world accumulation in Amsterdam was unthinkable. In the North Atlantic above all, 'wherever Dutch capitalists went . . . they were to be found draining swamps, clearing forests, building canals, operating mines, building ships, mills, and factories for gunpowder, glass, textiles' (Wilson 1968, 78). The mistake is to view the North Atlantic in narrowly *European* terms, exempt from the New World pattern of commodity frontiers in sugar and silver. Environmental devastations ranged far and wide in the conquest of the Americas, from the canefields of Bahía and Barbados to the mining centres of Potosí and Zacatecas. But were these ecohistorical moments of rapacious European colonialism from which Europe was exempt? Or were they, perhaps, moments in the globalization of commodity relations that extended to the Vistula, to Stavanger, to Viborg? The emergence of this increasingly modern North Atlantic zone – a major place among many, occupying and producing the place of the capitalist world-ecology (Moore 2010, 2003b) – had much in common with the creation of an increasingly modern South Atlantic, home to the great slaving, sugar and silver mining commodity frontiers featured prominently in the historiography of European expansion. There was, in short, a 'great frontier' *within* Europe no less than outside it (Webb 1964) – and this great frontier was propelled by an interlocking web of *commodity* frontiers.

The story of the Dutch economic miracle has been told often and well (see, *inter alia*, de Vries 1974; Wallerstein 1980, 36–71; Aymard 1982; Israel 1989; van Zanden 1993; Arrighi 1994, 127–58; de Vries and van der Woude 1997; Hoppenbrouwers and van Zanden 2001). Its equally miraculous political ecology remains, however, largely hidden.¹ Making this political ecology visible entails, from the outset, a significant choice. One option is to trace the environmental transformations of Dutch capitalism. This would begin from the social formation of Dutch capitalism and trace the successive waves of environmental transformation that issued from it. 'Environmental history *of*' might be counterposed to the perspective of 'environmental history *as*'. If the first perspective views Dutch capitalism as a social project with biophysical consequences, the second – environmental history *as* – views Dutch capitalism simultaneously as a social and ecological project, one whose development entrained a vast web of socio-ecological transformations.

This is the perspective of capitalism as 'world-ecology' introduced in Part I (Moore 2010). At heart, this perspective offers a simple proposition: capitalism does not act upon nature so much as it unfolds *through* nature–society relations. It is a protest against, and an alternative to, the Cartesian worldview that puts nature in

¹ There have been some important contributions (e.g. de Zeeuw 1978; Unger, 1984; van Dam 2001). My point is that these have not attempted a reinterpretation of Dutch hegemony *as* environmental history.

one box, society in another (Moore 2009b). This alternative views the great movements of modern world history – industrial and agricultural revolutions, successive ‘new’ imperialisms, social revolutions, the formation and development of the world market – as socio-ecological projects and processes aimed at reconfiguring nature–society relations within their respective fields of gravity. ‘Nature’, no longer a passive substance upon which humanity leaves its footprint, becomes an active bundle of relations formed and re-formed through the historically and geographically specific movements of humans with the rest of nature. Capitalism, as world-ecology, first emerged during the tectonic shift in the Atlantic world’s locus of power after 1450. It was a shift from power over territory to power over the fruits of commodity production and exchange. And though this shift is often perceived in terms of colonial expansion, the central issue was not the colonization of space but the conquest of time. The new imperative was ‘to command surplus labour *time* and convert it into profit within the *socially-necessary turnover time*’ (Harvey 2001, 327). It is for good reason that Mumford (1934, 14) regards the clock as the decisive machine of modernity: ‘The clock . . . counted a regular, repeating sequence of discrete actions . . . rather than tracked or continuous, regular motion such as the moving shadow of a sundial’ (Landes 1998, 49). It offered, in other words, the possibility of an epochal rupture with feudalism’s ‘narrow dependence on natural time’, quite literally establishing the socio-material basis of modern labour productivity (Le Goff 1988, 181; Landes *op. cit.*). It was precisely this colonization of time that propelled the extraordinary geographical conquests of early capitalism.

The century after 1450 witnessed the emergence of capitalism’s holy trinity, as the endless accumulation of capital, the endless conquest of nature and the commodification of everything were systematically (albeit unevenly) combined. The very rapidity of the commodity revolutions that ensued – enabled by a remarkable series of innovations in productive techniques, from shipbuilding to mining and metallurgy to printing and sugar processing – radically reshaped nature–society relations in one region after another. The serial character of these revolutions was paramount, and one that found no precedent in world history. Driven by the competition of states and firms for access to the riches of commodity production, the era’s commodity-centred revolutions generated unceasing demands upon biophysical nature, not only more and more, but *faster and faster*. An ever-expanding quantum of nature was heretofore to be governed by ‘a regular, repeating sequence of discrete actions’, not the moving shadow of the sundial. As these human and biophysical natures were successively exhausted, *given the extant socio-technical organization of production*, greenfields were sought out, and the commodity form globalized.

So what may seem at first glance a trivial terminological manoeuvre – capitalism as *world-ecology* – is intended to illuminate a substantive *problematique*. With the rise of capitalism, varied and heretofore largely isolated local bundles of socio-ecological relations were incorporated into – at the same moment becoming constituting agents of – capitalism as ecological regime. The geography of the commodity frontier, driven forward by the time-discipline of an emergent capitalist order and the contradictions of its peculiar socialization of nature, was fundamentally globalizing. Hence the hyphen: we are talking not necessarily about the ecology of the world (although this is in fact the case today) but, rather, a world-ecology.

From this standpoint, Dutch hegemony appears as an irreducibly socio-ecological bundle of relations, acting *through*, rather than upon, the rest of socialized nature. Indeed, the socio-ecological moments of Dutch capitalism were so tightly woven together that it is hard to know whether a strong distinction between natural and social process offers much descriptive, never mind explanatory, power. Just when and where, we may ask, did the 'natural' moment of the Dutch herring fleets leave off, and the 'social' moment begin? When the fish were hauled out of the seas? When they were packed? When they were offloaded back in port? When they were shipped to markets in Warsaw? When they were purchased and *eaten*? The two moments, as Raymond Williams might say, are mixed so deeply in historical capitalism that it has become impossible 'to draw back and separate either out' (1980, 83).

This is the argument of what is now a rather large body of social theory – call it constructivism, relational ontology or the production of nature (see, *inter alia*, Harvey 1974, 1996; Smith 1984, 2007; Braun and Castree 1998). There remains, however, a rather large divide between the 'red-green' insights generated by this social theory of the environment, and the conceptual and methodological premises of the theory of social change in the modern world (e.g. Anderson 1974; Wallerstein 1974; Arrighi 1994; Tilly 1990). A 'greening' of the latter is overdue, and this bears directly on our methodological argument. How does one go about discerning, and *relating*, the social and the biophysical in the explanation of world-historical social change? This is a very large question, and I can only scratch the surface here. One may, of course, choose to emphasize certain 'biophysical' transformations (for example, soil exhaustion or deforestation) over certain 'social' transformations (for instance, the differentiation of the peasantry). The methodological issue turns on a strong and weak bounding mechanism between nature and society, and this in turn rests upon one's conception of the *relations* that form (and re-form) these abstractions (Williams 1980; Moore 2009b). In Part I, I argued for establishing weak boundaries between large- and small-scale socio-ecological change, such that we may engage in a 'dialectical tacking' between inside and outside, large and small, and the manifold ways in which these are reworked in the history of capitalism (Moore 2010, 43). Such a dialectical tacking is as necessary for the relations of the global and the local as it is for the relations that give rise to nature and society. Our alternative implies, and indeed necessitates, a porous bounding of nature and society, premised on a methodology that views the relation between the two as generative, fluid, provisionally stabilized and at the same time subject to violent and rapid disruption.

The Global North Atlantic was one such provisionally stabilized field of power in the rise of capitalism. It was the pivotal zone of the vast but weak world-ecology of the long sixteenth century (*c.* 1450–1648). The region was home to the most effective accumulators of capital in the centuries after 1557 (first the Dutch, then the British), providing the strategic raw materials indispensable to the consolidation of capitalism – timber, fibre crops, naval stores, metals, cereals and whales. I am not so sure that this early modern North Atlantic, pivoting on Amsterdam, is best described as a creation of merchant capitalism (e.g. van Zanden 1993) – although there is no denying that distributional capacities were indeed central. De Vries and van der Woude are quite correct to bend the stick in the other direction, emphasizing the technical and organizational innovations within the 'first modern

economy' (1997). I would take the argument one step further: 'The first modern economy' was indeed Dutch, *but not only Dutch*. In what follows, I take as my guiding thread Hobsbawm's fertile suggestion that we consider 'all the maritime states [of the seventeenth century] . . . as one large, diversified *home market* . . . [a] *collective home market*' (1965, 49, 57, emphases added). In de-linking the category of home market from the naturalized geography of the nation-state – 'to take the political boundaries of the state would be too mechanical' (Lenin 1956, 600) – Hobsbawm's suggestion may be reinterpreted more expansively. Did not an expansive (and expansionary) North Atlantic comprise a vital, self-propelling and self-contradicting matrix, unifying the era's three decisive (if overlapping) accumulation sectors: (1) the production of the means of production (shipbuilding above all); (2) the expansion of consumer markets, albeit more extensively than intensively; and (3) the 'primitive' organization of successive agro-extractive resource zones? To say that the 'collective home market' of the North Atlantic was decisive for capital accumulation in northwestern Europe is not to argue that 'national' home markets in the maritime Low Countries, and then England, were somehow epiphenomenal. To say *market* is always to speak in the plural; we are dealing with layers within layers, markets within markets, and the unstable articulation of (medieval) market *places* with (capitalist) market *spaces*.

This 'collective home market' began from a nucleus that comprised the British Isles, France, the Low Countries, the German commercial ports such as Hamburg and parts of Scandinavia. As the mid-sixteenth century crisis drew a curtain on the first sixteenth century and introduced a second, the Global North Atlantic would expand through successive commodity frontier movements. These movements would incorporate, by the end of the eighteenth century, the greater Vistula Basin, all of Scandinavia and even as far north as Svalbard, the present-day Baltic states, Russia as far as the Urals, and the eastern reaches of North America. It would become progressively intertwined as well with the plantation economies of Wallerstein's 'extended Caribbean' (1980, 175) and Braudel's 'global Mediterranean' (1972).

If, at least until the end of the seventeenth century, all roads in this global North Atlantic led to Amsterdam, it may be useful to begin the specificities of the Dutch Road to capitalism.

ECOLOGY AND THE DUTCH ROAD TO CAPITALISM

The Dutch Road begins in the sinking peat bogs of the fifteenth century. The Low Countries escaped the worst of the Black Death, which Slicher van Bath (1963) attributes to a better diet relative to the rest of western Europe. But why a better diet? In part, this was an index of seigneurial power; strong peasantries are typically well fed. And partly this was a sign of the region's socio-ecological vitality, enjoying 'substantial grain . . . harvest[s]' at a time when yields were falling throughout Europe (van Dam 2001, 34; Moore 2007, ch. 1). This vitality gave way to crisis in the opening decades of the fifteenth century. Massive peat mining and land reclamation between the ninth and fourteenth centuries 'completely demolished the soils and created huge lacks' by the dawn of the fifteenth. Large parts of the maritime Low Countries were quite literally sinking into the North Sea (van Dam 2001, 32). It was at this point that

what turned out to be a very large – and rapidly growing – part of the rural population suddenly found itself, *due to profound ecological disruptions*, unable to make a living by arable farming and compelled to find productive activities in which they could successfully compete on the market. *Unlike anywhere else in Europe*, the subjection of the agricultural population to dependence on the market and the rise of a large market-dependent population involved in trade and industry in the town occurred to a very great extent as part of a single process of agrarian transformation. The emergence, on the one hand, of Dutch clothmaking, brewing, shipping, shipbuilding and peat digging – much of which was oriented to export – and, on the other, of Dutch dairy and cattle raising, were thus two sides of the same extraordinary process of ecologically driven separation of the direct producers from their means of subsistence leading to the transition to capitalism, and they must be understood together. (Brenner 2001, 206, emphases added)

Herein lay the origins of the Dutch Road, in the region's distinctive response to the specificities of feudal crisis. 'Ecological processes' acted in a manner 'strikingly analogous to "the so-called primitive accumulation" that deprived agricultural producers of their land in England' (Brenner 2001, 208). Here, the social basis of modern economic growth is revealed not so much as social, but as irreducibly socio-ecological!

This ecologically enforced 'market dependence', to use Brenner's apt formulation (2001, 177), underpinned the competitive position of Dutch agriculture and industry in the long sixteenth century. Rising agro-industrial productivity in the maritime Low Countries allowed its capitalist organizations to move from strength to strength in the second sixteenth century. Here was a virtuous circle indeed. Market-dependent agriculture compelled rising productivity, which facilitated Dutch primacy in the Baltic trade. And primacy in the Baltic trade reinforced its domestic agricultural revolution. Dutch farmers, freed from the imperative to cultivate cereals (a low-profit line), shifted to dairy and other high-profit pursuits.

It was a virtuous circle with a vicious underbelly. For the socio-economic history of Dutch success was enabled by a socio-ecological history of productivity and plunder in one resource frontier after another. This was decisive to the emergence of the Global North Atlantic. It was a logic of ecological hit-and-run. *Hit* where the ecological wealth was most accessible (cheapest), extract it as fast as possible, then move as quickly as possible once declining ecological returns registered falling profitability. 'Economies of speed', to use to Chandler's gifted turn of phrase (1977), were therefore decisive in the specifically capitalist instantiation of the 'metabolic rift' (Foster 2000; Moore 2000a). The acceleration of biophysical appropriation in the 'countryside', for the benefit of urban capital, exhausted agrarian spaces, thereby creating the basis for an aggressive frontier strategy. Thus Antwerp's and then Amsterdam's successively more expansive town-country antagonisms, and the commodity frontiers they entrained, cannot be explained as the expression of rising demand alone. The market for food and raw materials did indeed expand quantitatively, but the global reach of the relevant commodity frontiers expanded even faster. They had to, given the matrix of technology, business organization and biophysical bounty that crystallized in this early capitalist ecological regime. This

matrix compelled ceaseless efforts to reduce turnover time in concert with maximal resource extraction (defined by the productivity of labour), in the process speeding up the rise and demise of raw material zones beyond anything known in previous modes of production. The upshot was a rapid-fire succession of commodity frontiers in many basic sectors of the European economy.

This commodity frontier strategy, central to the making of the Global North Atlantic, found one of its key motors of transformation beyond the North Atlantic. (But not, I would emphasize, beyond the capitalist world-ecology.) As we learned in Part I, this exogenous prime mover was the trans-Atlantic Iberian ecological regime. The Iberian ecological regime spelled short-run disaster for the Andes, and for Spain as well over the middle run – the first moment extended the second. But this South Atlantic regime was spectacularly successful at delivering the mineral riches of the Americas to the North Atlantic. Not for nothing did it 'become customary to say that "Spain is the foreigner's Indies"' in mid-sixteenth century Castile (Vilar 1976, 160). The production and delivery of Andean silver, and the contemporary production of North Atlantic grain, timber and metallurgical surpluses, were key parts of a unified (if uneven) process – the formation of the capitalist world-ecology.

We begin with cheap food. The Dutch began the long sixteenth century with the highest grain prices in western Europe, and ended it with the lowest (de Vries and van der Woude 1997, 199). Cheap grain in turn underwrote the rapid growth of the non-agricultural workforce over the course of sixteenth and seventeenth centuries. The population of the northern Netherlands more than doubled over this period, while the rural population increased by just one-third (de Vries and van der Woude 1997, 208). Somewhere between 30 and 60 per cent lived in cities, three-quarters of them in 'large' cities with 10,000 or more people (Wallerstein 1980, 45; Berry 1990, 103; DuPlessis 1997, 72). With just 1.5 per cent of European population in 1650, the northern Netherlands was home to one-sixth of Europe's largest towns, those with more than 40,000 people (calculated from McEvedy and Jones 1978, 62–65; Parker 1979, 23, 40). Amsterdam, with just 11,000 residents in the early sixteenth century, tripled in size by the 1580s, and reached 200,000 by 1650 (Davis 1973, 180; Wallerstein 1980, 45; de Vries and van der Woude 1997, 358) – nearly twenty-fold in just a century! Already by 1560, Baltic grain met about 15 per cent of Dutch needs (Elliot 1968, 48; de Vries and van der Woude 1997, 198; van Tielhof 2001). By the turn of the century, probably half the population of the most urbanized, and therefore most commercialized, provinces (Holland, Utrecht, Friesland and Groningen) relied on grain imports for their daily bread (de Vries 1974, 172).

But why *Baltic* grain? The explanation turns on some combination of environmental history and political economy. In the first place, when we say Baltic grain what we really mean is *Polish* grain. And this had everything to do with the geography of the situation. Poland was, to put it simply, a frontier zone. It had been so since the great colonizing movements of the eleventh century. By the middle of sixteenth century, however, the frontier meant something different. The Danzig–Vistula zone was not a frontier of sparse population and abundant land (although some of this reality persisted); it was above all a *commodity frontier*. If the commodity frontier in some places, such as the sugar zones of Brazil's north-east, implanted

capital-intensive ‘factories in the field’, in others the impact was precisely the opposite. The crucial issue was cheap food, and in the short run it mattered little whether it was produced by serfs or capitalist farmers. With relatively abundant land and a balance of class forces favourable to the forcible extraction of surplus, Poland was the only cereal zone in Europe from which significant surpluses could be won. Sicily had come on-stream in the early sixteenth century, but was showing signs of exhaustion by the end of the century. The Mediterranean as a whole would disappear as a grain exporter after 1590 (Parker 1979, 39). Poland, however, a kind of second ‘America’ in Braudel’s words (1984, 207), was relatively free for the taking, and it retained plentiful supplies of fresh soil. For the time being . . .

Cheap Grain and the Baltic Frontier: A Silver Lining

Our second point concerns the ways in which Dutch agro-industrialization linked up with silver, so central to our story in Part I. By the later sixteenth century, the Dutch innovation in the Baltic was to capitalize on the favourable conjuncture provided by huge silver flows on the one hand, and ‘booming western demand for Baltic grain’ on the other (Davis 1973, 180). Dutch manufacturing prowess was significant, but on its own insufficient to forge a semi-colonial relation with the Baltic.

The Baltic trade may have been semi-colonial, but it was a strange sort of colonialism, one in which the *Dutch*, not the Poles, ran a persistent trade deficit. Ready cash was therefore the decisive intervening variable (Braudel 1984, 209).² And ready cash meant silver – Attman (1983a, 10–12) puts net flow of silver into the Baltic at some 50 tons *annually* during the seventeenth century³ – and silver could be got most readily from the Spaniards. (Hence the importance of Dutch trade surpluses with the Mediterranean and the New World.) ‘There is little doubt that the Baltic was the drain down which disappeared much of the American silver which Spain mortgaged to Amsterdam for Dutch imports. The ultimate destination of much of the contents of the Silver Fleets was the [Danish] Sound’ (Wilson 1949, 153–64; Wilson 1951, 235). An overstatement, no doubt – we have learned so much about the Manila Galleons and the flow of silver to the Far East in recent decades (Frank 1998; Flynn and Giraldez 2002) – but it is nevertheless quite clear that large volumes of American silver were flowing into the Baltic by way of Amsterdam (Barbour 1950, 52; Attman 1983a, 31–7, 103; North 1989, 1992; Barrett 1990, 250–2). And nowhere in Europe did American silver ‘cause the price of agricultural products to soar’ more than in Poland (de Maddalena 1974, 308).

Just how much American silver flowing into Spain wound up in Dutch hands? Barbour thinks 15–25 per cent, but cites higher estimates too (Barbour 1950, 50; see also Attman 1983b, 29–31). Whatever the precise figures, the acquisition of American silver was sufficient to transform the economic geography of northern Europe

² Among other things, it reduced the price of credit relative to that available to English merchants (Lambe 1657, 9–10).

³ Attman (1983a, 10–12) takes pains to emphasize that this is an enormously conservative estimate, one that omits the overland transport of specie, and relies heavily on registered exports from European ports. On the other hand, de Vries and van der Woude (1997, 84–7) sound a sceptical note, arguing that Dutch ‘invisible’ earnings from shipping and commercial services had a moderating effect on Attman’s estimates for bullion exports from the Republic.

– sufficient, at least, once integrated into the political ecology of Dutch hegemony. There is no call for bullion fetishism here. Directly and indirectly, silver served ably as a reliable medium of exchange in an era when confidence in the long-distance transactions was shaky at best (Wallerstein 1974, 38). Quickly recognizing the power of ready cash, the Dutch capitalized on the situation by pursuing what Wallerstein calls a system of 'international debt peonage' (Wallerstein 1974, 121–2; see also Malowist 1959). Superior access to mobile capital allowed Dutch merchants (through Gdansk/Danzig intermediaries who bore much of the risk) to make advance payments to Polish landowners:

This prevented sale on an open market. It allowed the merchants rather than producers to decide the optimum moment for world resale. And since the money lent tended to be expended by the time of delivery of the goods, if not overspent, the producer was always tempted to perpetuate the arrangement . . . [Dutch] merchants could thereby take the profits of the price revolution and multiply them. (Wallerstein 1974, 122; see also Malowist 1958, 1959, 1960; Braudel 1982, 419–20; Banaji 2007, 66)

What I would like to stress about Poland's deepening financial dependence on the West is how such financial mechanisms called forth a strikingly modern political ecology. 'International debt peonage' – familiar enough in the era of neoliberalism – was an ecological no less than social project. While Poland's (under)development owed something to the peculiarities of settlement expansion in the medieval period (Brenner 1985), the *consolidation* of a cash-crop monocultural regime in rye and wheat, worked by serf labour, owed much to the Dutch organization of credit and trade. By absorbing Polish agricultural surpluses into its North Atlantic town–country division of labour, the Dutch were able simultaneously to facilitate their movement into high-profit lines (both agricultural and industrial) *and* block the incipient development of mercantile and manufacturing activities in eastern European cities. In Poland, no less than in the Americas, economic power and financial innovation – superficially 'social' phenomena – were closely intertwined with the commodity-centred production of nature. (We shall have opportunity to visit the political ecology of Baltic cereals presently.)

This 'external' moment of Dutch agro-ecological innovation was complemented by an 'internal' agricultural revolution. Dutch agriculture was the Continent's most advanced (Slicher van Bath 1963; Grigg 1974; Wallerstein 1980; DuPlessis 1997). At a time when grain yields stagnated or rose only slightly throughout Europe, Dutch agriculture surged forward in the sixteenth and seventeenth centuries (Davis 1973, 110, 116; de Maddalena 1974, 312). By 1600, grain and milk yield ratios were 'double or triple those achieved . . . outside the Netherlands' (DuPlessis 1997, 73). Some rye and wheat continued to be cultivated – indeed, Dutch yields were the highest in Europe in the later sixteenth century (van Houtte and van Buyten 1977, 85). But this was only part of the story. The 'invasion' of cheap Baltic grain amplified the market-dependent thrust of the ecological disruptions that Brenner identifies, driving Dutch farmers towards cattle and dairy production, as well as industrial and garden crops (de Vries and van der Woude 1997, 195–234). Across the maritime regions, villages with 'extensive arable land [in the sixteenth century] . . . had none

in the seventeenth' (van Houtte and van Buyten 1977, 85; see also de Vries and van der Woude 1997, 200; DuPlessis 1997, 72–3).

FROM THE FOREST A MIGHTY EMPIRE TAKES SHAPE – OR, ISN'T IT GOOD, NORWEGIAN WOOD?

Everything turned on the forest. Very little of the Dutch miracle was possible without timber and forest products, or without fresh land carved from the forest. In this respect, the Dutch occupied an even weaker geographical position than did Castile. Peat compensated for the lack of forests to some degree, and could be used for industrial and domestic heating, reducing urban pressure on the forests for charcoal and firewood.⁴

Alas, ships could not be built from peat: 'Of all the European powers, the Dutch had the most unfavourable ratio of domestic forests to overseas ambitions' (McNeill 2004, 397; see also Albion 1926, 169). Indeed, the *immediate* hinterlands of Dutch shipbuilding centres offered less good timber even than Venice, perhaps the most famous instance of early modern timber scarcity (Appuhn 2000). And yet, if the Dutch had so little timber in their hinterlands, why was Sir Walter Raleigh lamenting England's sylvan poverty, relative to the Republic, at late as the 1650s? The United Provinces' access to the 'exceeding Groves of Wood in the East Kingdomes' yielded 'huge piles of Clapboard, Firdeale, Masts and Timber . . . in the Low Countreyes, where none groweth' (Raleigh 1653, 26). In what follows, we trace the commodity-centred conversions of American silver into shipbuilding timber, other forest products and Baltic cereals, carried forth in those extraordinary seaborne forests, the merchant marines of northwestern Europe.

Wherever Dutch capital set ashore, it set in motion new commodity frontiers in grain and timber. And this meant strong if uneven pressure on those forests within the orbit of Dutch power. One needn't postulate a continental forest crisis to see that these commodity-centred environmental transformations were implicated in recurrent waves of capitalist expansion across northern Europe.⁵ These transformations owed much to the remaking of New World political ecologies – not only through the connection with silver frontiers, as we have seen, but also thanks to a trans-Atlantic trade pivoting on the sugar/slave nexus. The retreat of forests throughout the extended Baltic was paired with the initial phases of the 'destruction of the Atlantic rainforest' in Brazil, so lucidly described by Dean (1995). The New World silver and sugar frontiers intersected with the Dutch agricultural revolution – and its attendant competitive edge in manufacturing – to drive forward a series of cascading environmental transformations, widening and deepening a specifically capitalist geography of production and exchange in the North Atlantic.

We may begin with shipbuilding and the timber commodity frontier, even as we recognize that far more than timber alone issued from Baltic and Scandinavian

⁴ Peat gave the Dutch a cheap source of energy for a range of manufacturing activities that would otherwise have been quite limited in the thinly forested Low Countries. It was not inexhaustible, however, and by the later seventeenth century peat extraction was characterized by the same logic of rising costs and geographical expansion we see in the era's other commodity frontiers (de Zeeuw 1978).

⁵ The debate over forest crises in early modern Europe dates back to Sombart (1921), and surely even earlier. It has revived in recent years with the resurgence of environmental history (see Allen 2003; Williams 2003; Malanima 2006; Warde 2006).

forests. Over the course of the early modern era, Dutch capital would cast 'an ever-growing net over the timber-producing capacities of Norway, Poland, and the Baltic states alike' (Jacks 2000, 23). But this was less *one* net – the fishing metaphor seems especially relevant for the Dutch – and rather more a *succession* of nets. Nets as webs of entrapment and as networks of power, this succession of commodity frontiers constituted the geographical law of motion underpinning the 'national' triumphs of the Dutch-, and then British-led, North Atlantic. (The Industrial Revolution was built with iron from Sweden and the Urals.) It was the skill with which these nets were cast, and the quality of the nets themselves, that gave Dutch shipping (and therefore Dutch power) a decisive competitive edge over its competitors, at least through the 1660s, driving down shipbuilding costs to between one-half and one-third those of the English (Albion 1926, 156; Barbour 1930, 267).

The first of these nets was cast upon Norway's southwestern coast. It was not for nothing, as we learned in Part I, that 'Amsterdam is standing on Norway' became a popular expression in the Republic. If 'the economic life of the Scandinavian countries was honeycombed by Dutch enterprise', in Norway, Dutch capital was the Queen Bee (Barbour 1950, 118; see also Braudel 1984, 251–4). The dramatic expansion of Dutch shipbuilding – whose tonnage increased *ten times* between 1500 and 1700 (Sella 1974; Unger 1992, 260–1) – moved in lockstep with the Dutch penetration of southern Norway. Norway, formally incorporated into the Kingdom of Denmark, emerged as Holland's principal timber colony after 1570. For Malowist, Norway's sylvan ascent was strongly related to rising timber prices at Danzig, especially after 1570. What was driving costs upward? 'Not only the general price increase [the "price revolution"], but also the diminution of the timber supply of Poland and Lithuania' (Malowist 1960, 36, 39). Chaunu (1960) is willing to go even further, seeing an 'identical phenomenon' of forest exhaustion in northern Spain between 1590 and 1610 (see also Moore 2010, 55–62). Chaunu implicates a 'crisis of timber' in the 'great structural crisis' of the seventeenth century Atlantic: 'Was not this crisis of timber an important characteristic of the general crisis that joins these two centuries?' (Chaunu 1960, 43).

Starting in the 1550s, sawmills spread like wildfires as the Dutch advanced into southern Norway. Nowhere to be found less than a century before, there were over 500 mills by the end of the sixteenth century. Sögner (2004, 45) sees 'large scale' timber purchases by Dutch merchants from 1580.⁶ What ensued was one of modernity's first great logging booms (Sevetdal and Grimstad 2003, 14). So important was Norwegian timber that the advance of Dutch capital across the North Atlantic, and the introduction of the greatest technological innovation of Dutch world primacy – the *fluitschip* (or 'flyboat', as it is sometimes translated) – coincide almost perfectly. The Dutch timber trade with Norway expanded quickly from the 1570s; the first *fluitschips* appeared in 1595, manufactured, yes, from Norwegian wood (de Vries 1976, 117–18; Derry 1979, 142).

As in the Baltic grain trade, Dutch agents in coastal Norway deployed the power of ready cash to buy when prices were lowest and sidestep the middleman (Barbour 1930, 273). Although barter was not unknown, silver was king: 'notarial records tell

⁶ Lunden (2004, 201) locates the decisive shift between 1528 and 1560, when the number of ships exporting timber increased more than sixfold.

about bags of silver in [ship]master's cabins' (Bruijn 1985, 130). Dutch merchants 'fetched the timber in their own ships, trading with the peasants on very cheap terms and leaving scarcely any profit' (Kiaer 1893, 332). The strategy was so successful that Dutch shipbuilders obtained masts and shipbuilding timber at prices below their *Norwegian* competitors (Barbour 1930, 273)! Securing high volumes of very low cost pine reinforced the overall commercial-industrial dynamic by making possible the mass production of *fluitschips* based on standardized design and a labour process 'inclining strongly toward standardised, repetitive methods' (Wilson 1973, 329; see also Unger 1978, 116). The new vessels were, moreover, 'more lightly built and thus had a shorter lifetime' (Cederlund 1985, 168) – probably not longer than a decade – which was possible only on the basis of an agro-extractive regime of low-cost timber, one premised in turn on abundant sylvan wealth and effective economic organization.

No wonder, then, that Norwegian and Baltic timber had definitively displaced Rhine Valley sources by the early seventeenth century (Unger 1997, IV, 9).⁷ Moreover, the North Sea was a free trade zone relative to Europe's heavily regulated river networks:

Rivers . . . were encumbered with man-made obstacles, mills, fish-weirs, and, above all, tolls. *The Rhine was probably the most heavily encumbered*, probably because there was more to tax than elsewhere . . . Further impediments, most burdensome on the Rhine, were the 'staple' and 'transshipment' rights exercised by some riverine cities. *So obstructive were they that they were at this time hastening the decline of the land route between Italy and northwestern Europe in favor of that by sea.* (Pounds 1990, 244, emphases added; see also Bamford 1956, 35)

While it would be unwise to speak of a generalized deforestation in Norway, there were indicators of scarcity in shipbuilding timber and naval stores by the 1660s (Davis 1973, 190). By this point, the Dutch were importing 300,000 cubic metres of timber annually from Norway (Sipkens 1996, 36) – de Vries and van der Woude (1997) put the figure closer to 375,000 cubic metres. It was a gigantic sum, the natural increment of no fewer than 400,000 hectares.⁸

The century-long expansion of shipbuilding timber and naval stores production, and the continuing growth of Norway's iron sector, combined to 'inflict [wood] shortage, and in some places devastation of the forests' (Sevetdal and Grimstad 2003, 10; see also Berg 1997). A noticeable 'thinning of the forests situated along the coasts' could be seen by the 1650s (Kiaer 1893, 332), inducing a shift towards eastern Norway's timber zones in the later seventeenth century (Sögner 2004, 45; Øyen et al. 2006, 321). It became a 'necessity . . . [to] float timber from the interior' to sustain exports (Kiaer 1893, 332; see also Sögner op. cit.). Smout and his colleagues identify the same trend in their analysis of the Ryfylke timber region in southwestern Norway. By the middle of the seventeenth century, 'the best timber was cut out and

⁷ Rhenish and Elbian sources would become important suppliers after Westphalia (1648), which coincides with Dutch decline (Barbour 1950, 91). German sources were available, but on balance these were not frontier sources, and therefore posed all manner of social and ecological barriers to treating nature as a free gift.

⁸ Assuming a natural increment of 1.5 cubic metres per hectare, and a conservative estimate of wastage in transport and sawmilling of 50 per cent (Moore 2007, chs 2, 4).

the smaller, remaining trees proved less saleable' (Smout et al. 2005, 125). Only timber 'in smaller dimensions' remained a major export item in the south-west (Sögner 2004, 45). Lillehammer puts it more baldly (1986). Observing a 75 per cent drop in Ryfylke's board production between the 1660s and 1680s, he argues that 'what . . . seems to have happened was that further deforestation in the easily accessible woods' drove the collapse of output (Lillehammer 1986, 108). 'The boom', Smout and his colleagues observe in surely deadpan fashion, 'had not produced sustainable forestry' (Smout et al. 2005, 125). By one reckoning, in the century after 1650, Dutch timber imports from Norway declined from 130,000 *lasts*, approximating 260,000 tons, to just 38,000 *lasts* (Sicking et al. 2004, 7).⁹ It surely was not coincidental that the purchase price of a new *buss*, the specialized fishing vessel of the Dutch herring fleet, nearly doubled over the same period (van Bochove 2008, 224–5).

The decline of Norway's timber exports was surely conditioned by factors beyond forest depletion pure and simple. Denmark sought to mobilize Norway's resources in classical mercantilist fashion. The Danish Crown barred the export of masts and 'other big stocks' in 1640 'under the pretext of Norway running out of timber' (Tossavainen 1994, 74; see also Lunden 2004, 202). But was it pretext? It is likely that relative depletion now threatened what remained of Danish power. And would not the pressure to apply mercantilist measures have been even stronger under conditions of escalating relative scarcity? There were indeed 'strict forest regulations' in the first half of the eighteenth century, but the sharp decline in timber exports were 'most likely due to the lack of mature pine timber' (Øyen et al. 2006, 322).

It is, in any event, doubtful that Denmark could move far in a mercantilist direction. For Denmark ran high and persistent balance-of-payments deficits with the rest of Europe, and these were only made good by enforcing a 'highly favourable' balance with Norway (Kent 1955, 69). Denmark was, in other words, a kind of poor man's Spain; Norway, a Scandinavian Peru. It was, certainly by the time of Westphalia, moving in an 'increasingly peripheral' direction (Wallerstein 1980, 224).¹⁰ By 1648, tolls in the Danish Sound were falling. Denmark's greatest asset was therefore Norwegian timber. Thus did the political ecology of world power in the eighteenth century reinforce and reproduce the tendency towards the 'sequential overexploitation' of one commodity frontier after another (Gadgil and Guha 1992).

⁹ England, it is true, would displace the Dutch in Norway. By the mid-seventeenth century (1765), English timber imports from Norway stood at 240,000 long tons, or about 335,000 cubic metres (calculated from Kent 1955, 72). From the standpoint of the commodity frontier, Norway's still-considerable timber exports reflected relative decline. The commodity frontier had moved to the Baltic, east of the Oder. This is revealed most strikingly in the data on mast timber. Between 1700 and 1770, during a century when England's timber imports 'rose steadily', shipments arriving from Norway held steady at 20,000 tons. Imports would rise to 40,000 tons by century's end, an absolute increase that conceals Norwegian's timber's declining share. By 1800, 150,000 tons of timber from Prussia, almost certainly from Königsberg at this juncture (see below), were arriving in England each year (Kent 1955, 62–4).

¹⁰ Wallerstein (1980, 222–5) assembles a persuasive list of tendencies reflecting Denmark's peripheralization, especially marked after 1648: (1) a shift from cattle to cereal monocultures; (2) the rising share of landownership by the nobles, at the expense of Crown and peasantry; (3) the rising importance of *corvée* labour; and (4) escalating state debt. Finally, the Danish state itself survived Charles X's efforts to incorporate it into Sweden in 1659 only through the intervention of the English, Dutch, and French Triple Alliance.

That Norway's forests were thinning is hardly in question. Norwegian masts 'were described as the worst in Europe as early as 1637' (Bamford 1956, 137) – no doubt an exaggeration (the source is English), but surely one with more than a kernel of truth:

[Norway] had supplied masts and timber to the Hanseats for centuries, and more recently [, between 1550 and 1650,] the Spanish, Dutch and English demands had drastically reduced the available supplies. The metallurgical industries and the enormous demands of the Norwegian lumbering industries, unrestrained by forest legislation or effective conservation measures, did much to ruin what remained of the forests, and to destroy the mast traffic in the last three decades of the seventeenth century. (Bamford 1956, 136–7; see also Bruijn 2004, 98)

By the later seventeenth century, escalating 'supply problems in Norway' (ibid.) led the Dutch – and increasingly now, the British – to resume the long march of the timber frontier. The Baltic timber trade quadrupled in volume between 1661 and the 1690s. In the decade of the 1660s, 1.5 million 'pieces' of timber passed through the Sound. Thirty years later, in just a single year (1689), 1.3 million pieces were shipped (Unger 1959, 215). In Russia, the fur trade was quickly eclipsed by naval stores – these latter 'the most rapidly growing categories of Russian exports' by the 1690s (Kotilaine 2003, 306) – in exchange for Dutch metalwares and munitions. Indeed, Dutch capitalists moved into coastal Russia to establish the first sawmills, as they had done in Norway a century earlier (Ozveren 2000).

Although forest products would still be drawn from the southern Baltic, with its epicentre at Danzig, the general movement was in the direction of the eastern and northeastern Baltic. The eastern Baltic ports of Königsberg, Riga and Reval supplied 8.6 per cent of sawn timber passing through the Sound in 1641, but nearly 32 per cent in the 1680s. The eastern Baltic, in turn, would be displaced by Finnish timber. The eastern Baltic's share of the Sound trade contracted more than half by the 1720s (to 14.4 per cent), and Finland's would rise, ballooning to nearly two-thirds by this point (Unger 1959, 215; Åström 1975, 1978; Layton 1993, 283). Dutch ships would reach as far north as the northern Dvina (where Archangel would soon develop) by 1578, ousting English competitors, and with renewed vigour in the 1630s (Tossavainen 1994; Kotilaine 2003, 311; Kagarlitsky 2008, 96).

But it was more than rising demand for forest products that propelled the renewed advance. The extensions of capitalism's field of play through the timber commodity frontier were uneven and successive, and this had to do with the political ecology of the situation. Norway would give way to the Danzig and the Vistula, then to Königsberg–Memel and the Niemen, Riga and the Dvina, and onwards to Viborg and St Petersburg (Albion 1926; Kirby 1990, 229–32; Smout, MacDonald and Watson 2005, 124–31).

Szcygielski sees a century-long advance into Danzig's sylvan hinterland after 1550, strongly linked up with the extraction of masts, naval stores, potash and other forest products (1967). Fraiture, looking at Flemish panel paintings using Baltic wood, reports that the thickest planks (those over 30 cm), were 14 per cent of the total in 1500. Just a century later, they had entirely 'disappeared'. Meanwhile, the

thinnest planks had risen from 35 per cent to 92 per cent (Fraiture 2009, 106). The biophysical evidence indicates:

difficulties in procurement and an increasing concern for economizing the raw material. The exploitation of smaller trees through time [can be seen in] . . . the reduction in the width of Baltic planks over time; the growing presence of planks with non-rectilinear medullar rays translates an increasing use of twisted or eccentric trees used; the preservation of sapwood and even pith on planks for the latter period reflects maximal exploitation of the trunk. (Fraiture 2009, 110)

Between 1610 and 1640, Danzig's exports of ash and 'finished planks' declined by 85 per cent, falling to almost nothing by the 1650s (Unger 1959) (although there would be a modest recovery after mid-century). In part, the steep decline was driven by war with Sweden (1655–60). But we may also count the 'destruction of the Polish–Lithuanian forests' by export sectors (Stone 2001, 198). Kirby puts it bluntly: '[T]he exhaustion of timber supplies in the Vistula hinterland persuaded traders to look eastward for the potash, boards, deals, pitch and tar' (1990, 230). The geography of bullion exports from northwestern Europe to the Baltic mirrored (and reinforced) the commodity frontier. Just as Danzig's bullion imports were drying up, in the 1650s, we find Königsberg enjoying a 30–40 per cent export surplus, made good by massive bullion inflows (North 1989, 61–2).

Danzig's decline was Riga's gain. The proportion of ships sailing from Danzig through the Sound declined by half between 1610 and 1690, from 40 to 20 per cent (Kirby 1990, 230–1). Ninety-six vessels set anchor in Riga's harbour in the first decade of the seventeenth century; by the 1650s, there were 263 ships, nearly 85 per cent carrying the Dutch flag (Zoutis 1960, 82).¹¹ Riga was by this point a bigger port than Stockholm, accessing the Dvina's vast hinterland (Stoye 1969, 151).¹²

Nor did the train stay in Riga for long. If, by the 1690s, Riga had emerged as Danzig's chief rival in the Baltic, the timber frontier would roll onwards well into the nineteenth century. By the 1880s around Königsberg, timber supplies from its 27,000 square miles of once thickly forested terrain were 'becoming scarce and dear. The distance to haul [was] increasing' (Brown 1884, 247). This movement was driven by the very intersection of endless accumulation and rising material throughput that lay behind the expansion of the silver commodity frontier to the New World. The 'Baltic timber trade', Albion reminds us,

was not a matter which affected Danzig, Riga, Longsoud, and other timber ports alone. Extending even into Bohemia, Galicia, and the Ukraine, it afforded employment to men living hundreds of miles in the interior . . . [As] the old sources of supply grew inadequate [because of overcutting, it] became *necessary to go farther and farther up the rivers and deeper into the woods away from the rivers*

¹¹ In absolute terms, Danzig remained the prime destination, for the time being; 1500 ships called on the port each year during the 1640s (Parker 1979, 326). The issue is one of relative movement.

¹² Here, I refer to the West Dvina River as the Dvina – not to be confused with the North Dvina, which finds its outlet to the White Sea at Archangel.

in order to find suitable trees, which naturally increased the price of timber . . . Even the rivers grew shallower as a result (Albion 1926, 143, 145, second emphasis added)

The shipbuilding timber frontier enclosed space out of all proportion to its quantitative demand for timber. Even in the late eighteenth century, shipbuilding timber made for perhaps 1 per cent of European consumption (Warde 2006, 40–1). The sector's demands were disproportionate because shipbuilding timber was highly selective and dependent upon slow-growing trees such as oak. 'Shipbuilders, because they needed grand and "outsized" trees, overwhelmingly oak, vociferously feared scarcity. This was in part because the curved "compass timbers" required for ships' parts *were not generally found conveniently amassed*' (Warde 2006, 40, emphasis added). Most shipbuilding timber was simply out of reach. High transport costs precluded moving timbers more than a few kilometres. Just how far this timber could be hauled overland is uncertain. Albion (1926, 145) thinks the limit was twenty miles from the rivers and Phillips (1986, 263) is prepared to go as far as ten leagues. This may be too generous. Although topography, climate and social relations did make such long treks possible, as a general rule the limit was much less (White 1980).

As if to go from the frying pan into the fire. Nor was timber the only vector of exploitation pressing upon the Baltic's forests. A wealth of forest *products* also flowed from eastern Europe into Dutch and English manufacturing centres. Wherever commodification reached a critical mass in European forests, there emerged a 'battle for wood' between competing industrial sectors – as we saw in our last instalment within northern Spain, between ironmakers and shipbuilders (Moore 2010, 58–61). In the Baltic, pressure on the forests was amplified not only by the contest between timber extraction and agricultural clearing, but also by two other sectors: tar and pitch, essential to protecting ships from water damage; and potash, crucial for gunpowder and bleaching fabrics. Both were devastating. They were perhaps the only activities in the European world-economy – aside from agricultural clearing pure and simple – that came close to realizing total deforestation. Deploying the same power of ready cash that we saw in the cereal trade (the two trades were in fact related), by the later sixteenth century,

Dutch merchants encouraged Baltic peasants to distil . . . tar for export . . . Peasants scorched the base of trees to kill them, allowed the sap to trickle down into the lower trunk for a couple of years, then felled the tree and heated the wood . . . to extract the sap . . . Forest-clearing was an intrinsic aspect of the tar trade, and Dutch merchants encouraged Baltic peasants to convert from a traditional forest economy to agriculture based on what and flax for export[, using tar-oriented forest clearance as a necessary intermediate step] . . . Large areas of Prussia, then southern Sweden and finally Finland were gradually cleared and converted in this manner, *creating a boom in cheap tar, wheat, and linseed oil that peaked in the seventeenth century*. With their formula of clear-cutting and 'total tar' distilling, Dutch merchants were able to sell tar at prices well below those of the sustainable pitch trade. Their success earned them the admiration and enmity of England and France. (Loewen 2005, 239–40)

Amongst the consequences of this admiration and enmity was the advance of tar-making to Canada at the end of the seventeenth century (*ibid.*).

This battle for wood was also joined by potash. Potash production was no simple expression of merchant capitalism, of buying cheap and selling dear. Potash was so profitable because it was central to the high value-added strategy of Dutch capitalism: 'Where did the biggest profit margins lie in textile manufactures? Not in spinning or weaving or growing wool but in the refined technology of dyeing and dressing the cloth which provided the key to the control of the markets' (Wilson 1968, 31).

Potash relied on oak stands as much as shipbuilding timber, and it was more profitable. Around 1650, Tossavainen explains, the 'middleman in a loading port' enjoyed a 40–90 per cent profit in the potash trade, but only 16 per cent in trading clapboard, 'the most important . . . type of timber':

Danzig merchants were using either subcontractors who felled the timber and burned the ordinary ashes needed in the refining process of potash, or the local magnate got an advance payment of a certain quantity of potash delivered to Danzig. *The subcontractors and landowners did not care about the future of the forests.* They felled large areas totally empty of hard wood such as oak and beech, best suited for potash production. When the forest was cleared, the subcontractor simply made an agreement with another landowner who still had suitable types of timber. This was especially disastrous to the oak, because it takes decades before oak is big enough to be used for waynscot¹³ . . . The short-sighted clear-cutting of forests together with the internal and external factors already mentioned were enough to cause a disaster in Danzig's timber trade. (Tossavainen 1994, 73–4, emphasis added)

The toll on the forests registered in Danzig's potash exports through the Sound, which collapsed after 1625. Rising twenty-fold between 1600 and 1625 (to nearly 11,000 shippounds),¹⁴ and peaking in the 1630s at nearly 20,000 shippounds annually, Danzig's potash exports would not again reach even as high as 3,900 shippounds for another century, until 1725 (North 1996, II 11–13). Sweden would pick up the slack, but again, the Swedish moment of this globalizing 'potash frontier' would endure for not more than a half-century (c. 1675–1725), to be displaced in turn by St Petersburg (North 1996, II 12–13).

Such was the deforestation around Danzig – 'the unreasoning greed of man [had] destroyed these trees' – that sand dunes invaded (Wessely 1873, 221–2, quoted in Brown 1884, 96–7).¹⁵ By the early eighteenth century, the dunes not only consumed nearby 'meadows and fields, . . . [but had] completely buried' two nearby villages (*ibid.*). A century later, the problem had become so advanced that only state intervention averted its 'growing danger . . . [to the] commerce of Danzig' (*ibid.*, quoted in Brown 1884, 120–1).

¹³ Waynscot, or 'wainscot', was a type of high-quality planking, made from oak, used in shipbuilding.

¹⁴ Twelve shippounds comprised one *last*, or about a ton (North 1996, II 12).

¹⁵ And not for the first time. During the Thirty Years War, 'the Swedes, who needed money, cut down vast areas of forest in Pomerania with the result that many regions were afterwards invaded by sand-dunes' (Braudel 1981, 365).

FEEDING THE WORLD(-ECOLOGY) AND THE FATE OF THE FOREST:
BALTIC GRAIN FRONTIERS IN THE CAPITALIST NORTH ATLANTIC

The sequential overexploitation and recurrent waves of forest exhaustion driving the emergence of this Global North Atlantic found its second great driver in agricultural expansion. Such expansion is, of course, the topic of one of the more intriguing debates within Marxist historiography (see, *inter alia*, Wallerstein 1974; Brenner 1977). I want to ask the reader to join with me in bracketing, for the moment, the thorny debate over the relative primacy of what is clearly the persistently seigneurial character of east Elbian agriculture and what is, equally clearly, the decisive role of east Elbian agricultural surpluses in the rise of the Dutch and the making of the Global North Atlantic. My question may be put squarely. Did the *geographical movement* of agricultural expansion and forest clearance in Poland, and the extended Baltic, crystallize a new world-historical pattern, what I am calling the commodity frontier? Or did it resemble more closely the medieval pattern of colonial settlement and gradual forest clearance?

Alongside the timber frontier, Baltic grain was the second major vector of sequential exploitation nourished by American silver. The two frontiers, grain and timber, 'degraded the forests of the Vistula basin and more generally those of southern and central Poland' (Richards 1990, 169; see also Malowist 1960). There was, as Szczygielski (1967, 97) puts it, a movement of 'exhaustive cultivation' in full flower by the second sixteenth century.

The dramatic expansion of Baltic cereal exports became evident in the 1550s, when the trade reached four times the volume of a half-century earlier (Malowist 1959; van Tielhof 2002, 43). What followed was the modern analogue of the Great Wall or the Pyramids of Giza, a capitalist Wonder of the World – 113,000 ships carried 6.5 million tons of grain through the Danish Sound between 1550 and 1650 (Wilson 1976, 20). About half these shipments originated in Poland. And 60 per cent of these were carried in Dutch bottoms until the middle of the seventeenth century (Glamann 1974, 461; Bogucka 1978, 14).¹⁶ *Poland*, in this instance, signifies an expansive region shaped by the Vistula, which

contained a larger volume of water than in our day, since the water-table was higher, thanks to the extensive forests. The Polish lowlands placed few obstacles in the way of river traffic, which operated along a whole network of rivers with the Vistula as the main artery . . . The supplying districts associated with the Vistula trade were thus in the sixteenth and seventeenth centuries substantially bigger than the 'hinterland' drained by that river alone – *which is itself bigger than that of the Rhine*. (Glamann 1974, 458, emphasis added)

In this second sixteenth century, Poland became a vast monocultural zone – or, more to the point, an ensemble of monocultures with grain as king. By the end of the sixteenth century, grain made for 70 per cent of exports; by the early decades of the seventeenth, 80 per cent (Bogucka 1978, 14). No wonder that Glamann (1974, 459) sees in sixteenth century Poland the 'lopsided development of agricul-

¹⁶ In the seventeenth century, three-quarters of the Baltic grain arriving in Amsterdam was re-exported (Glamann 1974, 461).

ture and forestry under the massive pressure of western demand! It was a lopsided development enabled by the alchemy of the commodity frontier. As zones of early exploitation were exhausted, new frontiers came on-line to make good the shortfalls – an old pattern perhaps, but one that now moved in decades rather than centuries. A quantity–quality shift, to be sure! By the early seventeenth century, ‘even very distant regions, five or six hundred kilometres from the Vistula estuary and Danzig’, were sending grain and timber down the rivers (Maćzak 1970, 125; Wazny 2002).

The road to core capitalism in the modern world has always been paved with cheap food. And cheap food issues not only from rising productivity in agriculture but also from the global extension of agrarian spaces (a distinction with much more overlap than commonly acknowledged, as early capitalism’s sugar revolutions reveal). The geography of town and country is central. The rapid urbanization of the northern Netherlands – the number of city dwellers nearly tripling in the sixteenth century – occurred at the same time as the rapid *agrarianization* of Poland. The two movements were strongly related. In Poland, the number of people living in cities fell by almost *one-third* over the seventeenth century, even as aggregate population increased by 20 per cent. Among other major European countries, only Spain suffered a meaningful drop in urban population, and this by just 5 per cent (calculated from Allen 2000, 8–9). The ecological moment of this double reconfiguration of town and country is easily missed but simply stated. First, given low agricultural productivity, a relatively decreasing urban population and a relatively increasing rural population meant a larger potential food surplus for export. All things being equal, fewer people living in Polish cities meant that more people could live in Dutch cities. And there is evidence that peasant diets were also squeezed by 1650, extending still further the food surplus available to the Dutch, and the degradation of human nature that it implied (Topolski 1962). Second, cities consumed forest products at a ferocious pace – above all, timber for construction and charcoal for manufacturing. The same town–country relation that shaped the allocation of the food surplus therefore also determined the distribution of energy surpluses. Less for the Poles meant more for the Dutch. This is one key to unraveling Wyrobisz’s ‘paradox’, through which early modern Poland was Europe’s strategic timber and forest products exporter ‘while simultaneously . . . her own industry felt the lack of this raw material’ (Wyrobisz 1985, 38). Was this not essentially the same process that we witnessed in Norway, where Dutch buyers paid less for timber than their Norwegian competitors?

Poland was to the Dutch what Ireland would become for the English: ‘an agricultural district . . . which happens to be divided by a wide stretch of water’ (Marx, 1977, 860). But if the political economy of the town–country antagonism seems rather straightforward – even if we still quarrel over the capitalist content of the combined developments – a big question still persists. Was there a significant *political ecology* of this uneven development in the long sixteenth century?

Some precious clues suggest an affirmative answer. Poland’s emergence as a vast agro-export zone compelled an equally vast movement of forest clearance. The timing of large-scale grain exports from the Baltic to the northern Netherlands, and the large-scale transformation of Baltic forest into arable land after 1550, were tightly connected. Williams and Richards suggest that somewhere between 500,000 and 700,000 hectares of forests were sacrificed to feed northwestern Europe and the

Mediterranean in the early modern era (Richards 1990, 169, 177; Williams 2003, 176). Just how much of this was concentrated in Poland remains unclear, but given the export data, two-thirds appears as an absolute minimum.

Like the sugar plantations of the Bahian Recôncavo in the same period, Poland's manorial cultivation rapidly mined the soil, and therefore represented a disproportionate share of this deforestation, as exhaustion compelled the creation of arable land from the forest. Just how big a share one might assign to manorial cultivation is probably impossible to know in its precise dimensions. And while it would be useful to know, assigning responsibility between the peasant and manorial sectors is probably less important than identifying the emergent properties of the relation between the two. The unstable and uneven articulation of what Parker (1979, 326) calls 'feudal capitalism' in the East, and 'bourgeois capitalism' in the West, was one pillar of an epochal shift in the scale and speed of forest clearance; the uneven and unstable articulations of these capitalisms with the peasant economy was another. We are dealing with layers within layers. Kula (1976, 114) puts forest clearance between 1550 and 1750 at 3,310 square kilometres in 'Great Poland', the expansive western zone centred on Poznań. Richards (1990) estimates 500,000 hectares for the extended Vistula. Was it possibly even higher? North (1996, II, 9) believes that 3.5 million cubic metres of wood were consumed *every year* during the 1630s, just for potash exports. Assuming very high forest productivity and highly efficient extraction, say 200 cubic metres per hectare, this level of potash production would have consumed 175,000 hectares in this one decade alone – more than one-third of Richards' estimate for the two centuries after 1550.¹⁷ This translates to a scale and speed of deforestation unknown before in human history, *except* for the deforestation ongoing at the very same time (1550–1750) in northeastern Brazil (Dean 1995; Moore 2007, ch. 6).¹⁸

How much grain was flowing from the Vistula breadbasket? Richards figures an annual average of 60,000 tons of cereal passing through the Sound during the sixteenth century. Periodization is crucial here. Braudel's 'second' sixteenth century (c. 1557–1648) is probably the more useful temporal unit (Braudel 1953). Malowist (1958) reports 10,000 *lasts* – one *last* amounting roughly to two tons¹⁹ – exported annually from the Baltic to western Europe at the end of the fifteenth century, and then a significant jump to 40,000 *lasts* by the 1540s. Shipments rose to 100,000 tons by the late 1590s, and to 120,000 tons annually by 1618 (van Tielhof 2002, 43). There were, of course, tremendous oscillations of the trade, driven by climate and war, but Richards' estimate for cereal's share of the deforestation appears sound. My guess is that aggregate deforestation was at least twice as great over the period 1550–1650, as much as one million hectares.

The fate of the forest and the fate of the soil were therefore dialectically bound. Perhaps Poland's respectable yields in 1550s – just barely above the European average – owed something to reclaiming arable land from the forests. If so, this

¹⁷ For an extended discussion of forest productivity and harvesting, see Moore (2007, ch. 2).

¹⁸ The furious pace of deforestation would also explain the reduction in biodiversity in early modern Poland and Lithuania: 'The originally most important tree species of the forest – the yew-tree – as well as species of wild animal like aurochs and wild horse, disappeared' (Dunin-Wasowiczowa 1993, 178).

¹⁹ A *last* was a measure of volume. In the cereal trade, one last typically weighed 2000–2500 kilogrammes (Dunin-Wasowiczowa 1993, 181).

would explain at least part of the subsequent downward revision of yield ratios, evident even before cereal prices declined in the early seventeenth century. For Szygielski (1967) the two movements, forest clearance and declining yield ratios, were closely linked. There were, he points out, two principal strategies for sustaining a grain surplus, even in the face of a middle-run tendency towards soil exhaustion. One could sustain output 'by deviating from the fundamental principles of rotation in tilling the soil' (Szygielski 1967, 97, 94). The second strategy was necessitated by the first. Exhausted land was abandoned, and new arable carved from the forest. Soil exhaustion and deforestation were two sides of the same coin.

It is quite certain that this double movement cannot be explained solely in terms of the extension of the modern world market. By the same token, we can be equally confident that the expansionary cycle of forest clearance and soil exhaustion was not the unmediated outcome of a peasant-seigneurial cycle, such as we witnessed during the long medieval expansion (Seccombe 1992). For one thing, the peasant economy was incapable of moving so fast. World market forces were strong, but not *that* strong; the peasant economy was expansionary, but not *that* expansionary. It was, rather, a situation in which the two forces combined in unstable and dynamic tension, preserving in crucial respects a set of pre-capitalist arrangements, even as these latter were entrained within – and recast by – the gravitational pull of Dutch-led capitalism. It was a combination, in other words, that amounted to more than the sum of its peasant, seigneurial and Smithian parts.

Poland's cereal exports crested sometime between 1600 and 1625, declining by one-quarter on the eve of Swedish invasion in 1655 (Parker 1979, 39). Poland had sustained a strong demographic expansion in the sixteenth century, which meant an expansion of the peasant economy (McEvedy and Jones 1978, 73–7). This accounts for one moment of the drive into the forest. The threefold expansion in cereal exports between 1540 and the early seventeenth century constituted another, linked but relatively autonomous, driver.

What emerges is the pattern of commodity frontier development that we see unfolding across early capitalism. Poland in the later sixteenth century remained, as it had been for medieval Europe, an open frontier, for the peasant economy and market-oriented seigneurs alike. During this half-century, 'there still seems to have been enough . . . virgin land to satisfy seigneurial ambitions for demesne expansion, so that land held by peasants was only occasionally absorbed' (Blum 1957, 829). After 1600, however, the seigneurs moved strongly against the peasantry: 'The expropriation of peasant holdings became much more general, so that an ever-increasing number of peasant holdings were reduced to cottars, left without any land at all, or had the size of their holdings much reduced' (ibid.).

Whether or not this is synonymous with a market-driven 'second serfdom' is another question. Is it possible that the seigneurial offensive of the late sixteenth century expressed not only a Smithian response to favourable markets, but also a response to the soil exhaustion issuing from a half-century of booming cereal exports? Were yields sustained through frontier movements and seigneurial appropriations, such that the relative exhaustion of land and labour was connected to intensifying seigneurial exactions? In this period, 'the nobles began to limit the area of their peasants' cultivation', and thereby to enlarge manorial cultivation. But this was only one moment of the seigneurial offensive; it was paired with expansion

'towards the east' (Malowist 1959, 186). And frontier expansion meant forest clearance.

The point I wish to underline is that the drive towards the 'expropriation of peasant holdings' and the drive into the forest were systematically combined in the second sixteenth century. They were movements of a singular socio-ecological process expressive of the commodity frontier. While the socio-spatial moment is crucial, so is the matter of timing. For the cereal and timber commodity frontiers (or was it perhaps a singular frontier?) produced not only space but time. We see, once again, a 50–75 year cycle of expansion and ascent, followed by decline – an especially dramatic decline in the case of seventeenth century Poland.

It is therefore not terrifically surprising that we see an agro-ecological crisis within Polish cereal zones by the middle of the seventeenth century. Van Tielhof (2002, 54) identifies soil exhaustion as a serious problem from the 1660s, at which point Szczygielski (1967, 86) begins to speak of a 'catastrophic' decline of agricultural productivity. Moreover, the ramping up of corvée labour by the market-oriented nobility deprived poor peasants of animals, thereby undermining a key source of soil fertility (Wallerstein 1980, 132). That yields were declining is widely agreed, from 5:1 in the mid-sixteenth century to 3:1 (or lower) in the later seventeenth century (Topolski 1962; de Maddalena 1974; DuPlessis 1997, 82). As if that wasn't bad enough, widespread deforestation led to mounting soil erosion problems as early as the seventeenth century – erosion representing a quantum leap in nutrient loss relative to more depletion – probably intensified by the cold, wet winters of the Little Ice Age (Wyrobisz 1985, 38; Dunin-Wasowiczowa 1993, 178; Klimowicz and Uziak 2001).

Was this crisis the outcome of the market orientation of Polish agriculture? Or was it, alternatively, the resurgence of a seigneurial–agrarian dynamic? The late seventeenth century was an era of 'severe agricultural depression' across the Continent, which in certain respects replayed the crisis of the long fourteenth century (Abel 1980, 182; Seccombe 1992). The question is one of relative causal weight. Abel provides one clue, arguing that the depression was 'less pronounced' in Scandinavia 'because subsistence agriculture *still played a larger part* in the management of farms and estates than in the neighboring countries, . . . [above all] east Germany and Poland' (1980, 178–9, emphasis added). The comparative strength of the peasant economy insulated some regional economies from the downturn. This was the diametric opposite of the logic of the fourteenth century's crisis.

Danzig's grain exports fell some 90 per cent between the late sixteenth century and the early eighteenth. It was, then, not the weakness, but the *strength*, of capitalist advance in Poland that drove the crisis. It was a crisis that resulted from more than a century of capitalist restructuring – *even, and indeed especially, as it preserved and reproduced on new terrain an ensemble of arrangements predating the rise of capitalism*. The commodity frontier strategy effected, in the same breath, the creative destruction *and* the preservation of extant socio-ecological arrangements: 'The colonial [and within Europe, semi-colonial] expansion of capitalism not only absorbed pre-capitalist economic systems; it created them' (Fox-Genovese and Genovese 1983, 59).

Poland was by the late seventeenth century undercut decisively by English grain. England shipped out 'more [grain] than all Baltic exporters combined in the first six decades of the eighteenth century' (de Vries 1976, 81). Surely we can explain this

in terms of rising English agricultural productivity and the capitalist relations that enabled it (Brenner 1985). But wasn't this higher productivity achieved in part by what Overton (1996, 117) describes as the 'cashing in on reserves of nitrogen under permanent pasture for short-term gain', productivity gains that would turn to stagnation after 1750 (Allen, 2004, 409)? And wasn't Danzig also undercut from the other direction by 'a shift towards the eastern Baltic' in the grain trade by the eighteenth century (Glamann 1974, 462)? This latter shift would in turn reproduce the deforestation that characterized earlier phases of the cereal commodity frontier – creating, for instance, widespread deforestation in Estonia and elsewhere in Baltic Russia towards the end of the eighteenth century (French 1983, 30–41; Veski et al. 2005, 1,384). It was, Wallerstein wryly observes, a 'self-consuming method' (1980, 133).

The Baltic grain trade's dramatic expansion after 1550 was, among many other things, a period of rapid forest clearance. Not only because arable land expanded and forest contracted, although this was important – grain, of course, moved on ships, and shipbuilding was aggressive in pushing the division of labour ever outward. Petty (1690, 5) estimated Dutch shipping at 900,000 tons in 1676. Spotting these ships an average life span of, say, ten years, this meant 90,000 tons of shipbuilding annually, which would have depended upon 126,000 cubic metres of timber²⁰ (and this for the Dutch alone). Using Warde's estimates, this translates to 1,708.5 acres annually (2006, 50). But here the figure is surely misleading. Not just any timber would do. His yield figures, presuming 73.75 cubic metres of timber per acre, may be reasonable for certain kinds of shipbuilding timber – planking, for instance – but is probably too optimistic for the most strategic materials, hulls and masts. Some clues point to a much lower yield when it came to shipbuilding timber. Perlin, citing a 1593 source, finds that 1,740 'mature oaks' made for 2,000 tons of shipbuilding timber (1989, 175). If so, we may build from Naish's (1957, 493) observation that 2,000 such oaks (1,740 tons) could be extracted from about 50 acres,²¹ for a yield of 39.4 cubic metres per acre for shipbuilding timber. Such low yields would explain why southern Norway in the 1650s was running low on shipbuilding timber – not from lack of forests, but from the 'cherry picking' characteristic of the shipbuilding timber trade.

THE SWEDISH IRON FRONTIER IN THE NORTH ATLANTIC ECOLOGICAL REGIME

The Industrial Revolution of the late eighteenth century would stand on the shoulders of the iron commodity frontier. In this section, we focus on the geographical movements of the iron frontier as it moved from Germany to Sweden, and thence to Russia and as far as North America, in the two centuries after 1550.

²⁰ Bamford (1956) reports that ships could last up to three decades, but this is an exceptional upper limit, and refers to well-maintained ships-of-the-line rather than merchant vessels.

²¹ Or forty trees an acre, a bit more than 10 per cent higher than Warde's guesstimate of 35.3 trees an acre (2006, 50), and just below what Smout and his colleagues (2005, 97) find for seventeenth century Scotland, at 42.9 'mature' oaks per acre.

In the second sixteenth century, two major geographical shifts in the iron sector warrant our attention. One was within Germany, the pre-eminent iron producer between 1450 and 1550; the other was at the scale of the European economy. In the century after 1550, the centre of German iron production shifted from the Upper Palatinate to the Siegerland. It was the Siegerland's great innovation to diffuse, on a large scale, the *haubergwirtschaft* – similar to English coppicing – a move premised on the equally large-scale displacement of deciduous trees 'with faster growing conifers, to replace fuel supplies more rapidly' (Ogilvie 1996, 278). Indeed, throughout Germany's mining zones, the transition to capitalism was accompanied by a transition from hardwood beech to fast-growing 'pioneer' conifers (Thomasius 1994, 117). And yet, for all the forest productivity advances of the *haubergwirtschaft*, the Siegerland would not be, as the Upper Palatinate had been, the world-economy's central iron producer. Coppicing, as the English would discover two centuries later, was a second-best option. Even highly productive coppices, at 20–30 years, would not yield much more than one-third to one-quarter the bounty of 'natural' timber stands (Kellenbenz 1976, 100).²² The open frontier remained the first, best option.

Scandinavia was the obvious choice, especially for low-profit lines in iron and copper. As we have seen, Norway emerged as the crucial shipbuilding timber frontier by the 1580s, at the very moment when the path of forest exploitation had led to rising timber prices in Danzig (Malowist 1960). But it was the rise of Swedish iron and copper²³ that made possible the full development of Dutch, then British, world power. This is a long story that cannot be told here in full. But we may underscore the significance of the mid-century depression – above all, the financial crises of 1557 – in driving forward a decisive geographical restructuring of capitalism. Within a matter of decades, the town–country antagonism that had propelled the first sixteenth century's expansion gave way to another. The first sixteenth century had flowed through Antwerp. The second would be channeled by Amsterdam (Spufford 2006). A century before, Antwerp had displaced Bruges, knitting together the sugar and spice trades of the Atlantic and Indian Oceans with the metallurgical renaissance of Central Europe. The second sixteenth would replace Antwerp and the Erzgebirge with Amsterdam and Potosí; Slovakian Neusohl would give way to Swedish Falun and its Great Copper Mountain; Madeiran sugar surrendered to the Bahian sugar mills; and Polish timber would be eclipsed by Norwegian wood.

Sweden's emergence in the 1580s as the pivotal 'swing producer' in iron and copper can scarcely be overemphasized. Let us concentrate on iron to illuminate the broader geographical shifts. The European world-economy depended on low-cost iron, and iron production was stagnating even as accumulation revived after 1570. Whereas iron output grew 6.25 per cent annually between 1460 and 1540, it grew barely at all between 1540 and 1600, and output growth between the mid-sixteenth century and the dawn of the eighteenth century was a scant 1.3 per cent a year

²² Agnoletti (2000, 4) sees an ever-greater divide between the timber yield of managed forest and 'clear cutting' in sixteenth century Venice, between 1:40 and 1:150.

²³ The lion's share of Europe's copper would flow from copper's incarnation of Potosí, Sweden's Stora Kopparberg.

(Moore 2009a).²⁴ Meanwhile, Sweden's exports of bar iron jumped at least sixfold – possibly eightfold – between 1600 and 1700 (Heckscher 1954, 93; Boëthius 1958; Braudel 1981, 381). This iron was decisive to Dutch and then English success. England's output grew as well, but probably not by more than 50 per cent over the course of the seventeenth century (van Zanden and Horlings 1999: 31). England's economic history in this period is unthinkable without Swedish iron – the relationship was one of 'absolute dependence' (Heckscher 1954, 93; see also de Vries 1976, 108–9). And let us not forget that England's agricultural revolution was a prodigious consumer of iron – a stunning 15 per cent of English iron consumption in 1760 was devoted to horseshoeing alone (Bairoch 1973, 491), never mind the ploughs! Without a steady and reliable stream of iron imports in the eighteenth century, from Sweden, and increasingly from the Baltic and North America, England's geopolitical and economic position surely would have suffered – not least in relation to its chief rival, France, where iron output expanded fivefold between 1720 and 1789, fully two and a half times faster than England's output growth (Nef 1950, 283).

Sweden's ascent had everything to do with its extraordinary sylvan wealth. 'It was', Heckscher (1932, 139) quietly observes, 'the quantity [of charcoal] rather than the quality [of iron ore] to which [Sweden] owed her privileged position'.²⁵ A historically low population density may rightly be held responsible for this, but such an explanation seems to put cart before horse. Climatic and pedological factors surely limited the demographic push, but more to the point was Sweden's distance from the commodity system. By the 1570s, Sweden was probably no more commercialized than most parts of New Spain or Peru (Malowist 1959; Anderson 1974, 179; Wallerstein 1974, 312–13) – possibly less so. It was a near-perfect commodity frontier.

But this geographical shift, like those that followed, was hardly the straightforward expression of the self-regulating market. The globalizing world market of the second sixteenth century would compel, but could not create, such a re-centering. This latter would require the state to create the conditions for renewed commodification and accumulation. It would require, in other words, an intensification of primitive accumulation strategies. In the re-centering of iron and copper production, Dutch capital began pouring into Sweden by the later sixteenth century, accelerating sharply on the eve of the Thirty Years War (Boëthius 1958; de Vries 1976, 107–8; Hildebrand 1992; Evans 2005). The role of the state was decisive. Swedish Absolutism was singularly effective in overseeing the production of ecological conditions sufficient for a rapid transition to *large-scale* production (Sundberg 1991; Hildebrand 1992). Sweden, it is true, offered biophysical advantages – abundant and accessible forests coupled with high-grade ores – that situated it favourably to German producers, who were already in serious decline (Heckscher 1932; Boëthius 1958, 149; Kriedte 1983).

²⁴ Averages calculated as simple, not compound, rate of increase.

²⁵ My emphasis is on charcoal. Sweden's *osmund* iron was renowned for its high quality throughout Europe. In contrast to English iron, *osmund* contained minimal phosphorous, and therefore was highly prized for its malleability.

And yet for all its natural advantages, it was not ecology but *political* ecology that was decisive to Sweden's ferrous ascent. As early as the 1570s, the Swedish Crown began to enclose forest for metallurgical activity. By the early seventeenth century, the Crown established an agency empowered to coordinate a 'forest rationing' system and the geographical dispersal of metallurgical production – segregating ore smelting from bar iron production – so as to limit fuelwood scarcities (Boëthius 1958, 152). This turned on the expulsion of traditional slash-and-burn peasant agriculture from those forest zones closest to the mining centres (Emanuelsson and Segerström 2002). The first such prohibition of swidden cultivation was announced in 1647, on the eve of a second great wave of iron-led frontier expansion. These territorialist activities aimed directly at sustaining increasing commodity production. Expansion, not conservation – or rather conservation *qua* enclosure as necessary for continued expansion – this was the whole point (Boëthius 1958, 152; Eriksson 1960; Hamilton 1997). On the basis of this unusually far-sighted ecological strategy of primitive accumulation, Swedish iron exports – a stunning 80 per cent of production (Rydén 1998, 390) – constituted a strategic reservoir of raw materials crucial to the expanded reproduction of first Dutch, and then English, territorial and capitalist power in the century after 1620. (It was this increment of iron output that allowed the fleets to stay afloat and the Caribbean sugar revolutions to proceed.)

And yet, even in Sweden, deforestation quickly materialized. By the 1690s, iron mills in the north-east met with rising prices in wood and charcoal, setting in motion an upward spiral of conflicts with the surrounding peasantry over the forest commons (Gräner 2005). By the 1720s, the 'tendency was widespread', Hildebrand reports, for ironmaking estates to 'build up [their] charcoal-supply system by buying out the local peasantry; *not uncommonly in a heavy-handed manner, with credit as a prime weapon*' (1992, 88, emphasis added). It bears more than a footnote to mention that by the 1750s growing 'alarm' over the state of forest resources prompted the Crown to impose a ceiling on iron output (Pounds 1990, 300). It was ineffective, and this is precisely the point. Charcoal prices spiked in the 1760s, and remained high until century's end. Here as elsewhere, there were layers within layers. The commodity frontier movement that pushed European iron production to the north was also in play within Sweden, as iron production moved northwards in the eighteenth century (Hildebrand 1992, 140; Isaacson 1998). As the nineteenth century approached, Sweden 'saw signs of an ecological crisis caused by overuse of scarce land resources', especially forest products (Eliasson and Nilsson 2002). This intersected with yet another phase of metallurgy's global expansion, this time in the direction of Russia and the newly independent United States (Jones 1982; Evans et al. 2002).

FISHING THE COMMODITY FRONTIER: COD, HERRING AND WHALES

The connections between the Low Countries, the Global North Atlantic and the commodity frontiers of the South Atlantic do not end with the metabolic rifts instantiated in the metals/grain/timber/silver nexus. Amongst the more surprising synchronicities is the near-simultaneous decline of herring fisheries and Poland's

agricultural crisis. Dutch herring exports travelled far. Between 1600 and 1650, 1,500 tons of the salted fish were consumed in Warsaw annually, and over 16,000 tons (nearly one-third of the catch) passed through the Sound every year (Unger 1980, 263; van Bochove 2008, 234). By 1640, the Dutch were hauling in 40,000 metric tons of fish annually, about 80 per cent for export (de Vries and van der Woude 1997, 251).

Apparently, this was too much for the extant fishing regime – especially when reinforced by Danish and German competitors, ‘who responded to growing Dutch [harvests] by increasing their own catch’ and in the process ‘destroy[ed] their own fishing grounds’ (Munro 2006, 18). (Did this lie behind the ‘final collapse’ of the Scania fishery in the 1620s [Unger 1980, 272]?) By 1650, the North Sea herring fisheries were in trouble. Richards (2003, 51) sees a ‘long, slow decline’. But was the crisis perhaps more pronounced, a bellwether of Dutch hegemonic crisis? (Recall that Norwegian timber exports had faltered and Polish agriculture was in crisis at this very moment.) De Vries and van der Woude see a ‘precipitous decline in the herring catches after the 1650s’ following an ‘absolute peak’ four decades earlier (1997, 419; see esp. 25–251; see also van Bochove 2008, 12). This was no small matter for an economy in which one-fifth of the population depended on the fisheries, directly or indirectly, for their daily bread – the value of the 200 million herring caught in the 1650s exceeded that of English woollens (Munro 2006, 19). It is in any event clear that herring yields per boat were declining, a difficult state of affairs for a sector characterized by low labour productivity and a ‘structurally low level of profitability’ (van Bochove and van Zanden 2006, 568). Yield declined and with it the rate of profit, which fell by more than half between 1640 and 1700 (van Bochove and van Zanden n.d., 8).

Poulsen (2008, 390) rightly observes that this was not an instance of absolute decline from overfishing. Rather, the chief problem was one of the fleets’ exhausting a given ‘patch of fish’. The North Sea was not one, but many, fisheries. The cumulative effect was one of relative exhaustion, found in the interface between the serial exploitation of patches and the socio-technical capacities of the herring fleets. Hence, after an exhaustive survey of the herring sector’s profitability and cost structures, van Bochove (2008, 233) concludes that ‘the environment . . . would be our main best bet to explain’ the secular decline of the North Sea herring fishery, both in terms of stagnating or declining catches, and declining income.

The same historical–geographical pattern was at play in Dutch whaling grounds as well. These began to show ‘quite certain’ evidence of declining yields at the same time as herring (van Bochove and van Zanden n.d., 9). The Dutch economy could not do without either – the herring trade kept the shipyards in business (with nearly 500 *busses* in the water during the 1640s) and whales provided the raw material for such crucial industrial products as bone (for textiles), soap, lubricants and lamp oil (Wallerstein 1980, 39–40; Richards 2003, 609–10).

The solution decided upon was an old one by the mid-seventeenth century – extend the frontier. Build a bigger net (or harpoon, as the case may be). Thus the period between 1640 and 1670 marks a new phase of the whaling and fishing frontiers. The whaling fleets moved quickly north and west into the Arctic, and they followed a ruthlessly modern logic:

No allowance was made for any sort of conservation or sustainable use of stocks. The Arctic bowhead herds became an open-access resource without any discernible management or restraint on the part of the users. From the early sixteenth century to the mid-nineteenth, as bowheads were killed off, *the whalers shifted to more and more distant, difficult and dangerous regions . . .* Over the entire period, *and in each phase of the hunt*, there was a slow reduction in productivity as the number of size of whales caught declined. For example, in the 1670s each Dutch whaling ship took an average each year of 6.4 whales . . . [I]n the 1770s, the annual average catch was down to 2.2 animals. (Richards 2003, 610, emphases added)

Herring's relative importance declined after the seventeenth century – the catch was no larger in 1800 than it had been in 1600 (Poulsen 2006, 3). By the eighteenth century, herring would give way to cod. The new frontier entailed a changing of the guard – Dutch *busses* gave way to the aggressively expansionary English and French cod fleets. Nevertheless, the geographical restlessness of the herring commodity frontier persisted within the limits of low profitability. The eighteenth century witnessed a succession of local booms off the coasts of Scotland, Norway and Sweden, none of which 'flourished for more than 50–60 years at a time' (Poulsen 2006, 2) – a by-now familiar cycle. Already in relative decline, the Dutch were boxed out of these resurgent fisheries, which explains the industry's failure to revive profitability. Meanwhile, cod rose to prominence and outstripped herring production several times over; but the Netherlanders' moment in the sun had passed and the English now led the way. By the 1780s, the world cod harvest approached 400,000 tons – ten times the herring catch of the 1640s.

If the herring frontier was articulated with the Baltic grain frontier – both showing signs of exhaustion in the mid-seventeenth century – the global extension of the cod frontier was metabolically linked to sugar's movement into the Caribbean. On the cod frontier no less than in whaling and herring, there was an inexorable movement to enclose ever 'wider area[s] . . . In response to [recurrent] local scarcities, cod fishers moved to new, unexploited coastal regions' (Richards 2003, 567–8). It was a movement that fed, and was in turn nourished by, the depredations of the Caribbean's sugar commodity frontier (Moore 2000b; Moore 2003a, 347–57). The sugar plantations ravaged the soils of the West Indies through their mobilization of African labour power, fed on cheap salted fish – the cheapness of which rested upon the cod frontier's capacity to treat the North Atlantic as a free gift to capital. So inexpensive was the imported fish that Caribbean planters in the 1650s found it cheaper to buy fish from New Englanders than to allow slaves to fish for themselves (Ligon 1657, 35).

Here was a definite rupture with premodern patterns. The North Sea fisheries had been overexploited in the seventeenth century. Three centuries prior, these fisheries had also shown definite signs of stress in the wake of the long medieval expansion (Hoffmann 2005). At that time, the crisis of North Sea fisheries led to a contraction of commercial activity in the fourteenth century; in the seventeenth century, it led to the globalization of oceanic exploitation. It was bound up with the crisis of Dutch hegemony, but not with the crisis of capitalism as a system. The globalization of the North Atlantic fisheries, then, prosecuted by French and

especially English fleets, was but one moment of global expansion that was the *sine qua non* of early capitalism.

THE GLOBAL ATLANTIC IN THE RISE OF THE CAPITALIST WORLD-ECOLOGY: FROM INTERPRETATION TO PARADIGM

There is a startling synchronicity to the patterns here. On the one hand, all commodity frontiers produced regionally specific boom-and-bust cycles. On the other hand, taken together, these frontiers created a roughly connected world-time. This is the 50–75 year cycle.²⁶ I have used the metaphor of teleconnection to convey, albeit in rough and ready fashion (but then, was not this the reality of early capitalism?), the proliferation and intensification of 'large, statistically significant signals' in one region, and 'equally large signals' in another (Bjerknes 1969).

The growing strength of these 'statistically significant signals', and the emerging durability of a 50–75 year cycle taking shape around the era's leading commodity frontiers, gives some weight to our case for viewing the Global North Atlantic as a place, and the leading regional ecological regime of early capitalism *qua* world-ecology. *Leading*, to be sure. Exceptional? I am not at all sure. The exceptionalism of European environmental history is implicit in much environmental history.²⁷ From this perspective, the real action of modern environmental history is found on the frontier, and the frontier was found in the New World (e.g. Cronon 1991; Dean 1995). As we have seen, this is about half-right. New frontiers of commodification were also found within Europe. While no one would deny the distinctiveness of Old and New World political ecologies over the *longue durée*, the analysis suggests a common – if uneven – historical geography shared by the North and South Atlantics. Commodity frontiers moved forward, boomed, went bust and relocated towards the frontier, in a remarkably consistent cycle of 50–75 years. This was, as we saw in Part I, the case with Potosí's moment of global pre-eminence (c. 1570–1620), which replayed on an extended scale Central Europe's metallurgical boom of the first sixteenth century (c. 1450–1520). Was this not remarkably similar to the middle-run pre-eminence of Norwegian timber between 1580 and 1650, succeeded by a series of Baltic timber frontiers whose exports through the Sound quadrupled between 1660 and 1700? And to the highpoint of Poland's agro-forestry complex (c. 1550–1625), displaced by England's agricultural revolution and by lush timber frontiers in the eastern Baltic and Finland in the long eighteenth century? To the golden age of Swedish iron, which, like Brazilian and Caribbean sugar planting, was not one but several frontiers – a second great iron frontier opening in 1650 after the initial boom that commenced in the 1570s? To the zenith of the Dutch whaling frontier (c. 1660–1720) (Richards 2003, 600)? And in the South Atlantic, outside the immediate scope of this investigation but nevertheless a crucial backstory, to the sugar commodity frontier in its successive movements across the Atlantic, from Madeira (c. 1470–1520), to São Tomé (c. 1530–1580), to Pernambuco (c. 1570–1630s) and Bahía (c. 1620s–1670s) in Brazil, and thence towards the Caribbean by

²⁶ These are not directly connected to Kondratiev waves of a similar duration, which does not rule out an underlying connection.

²⁷ Good introductions to the discussion on European exceptionalism in environmental history are found in Radkau (2003) and McNeill (2003).

the mid-seventeenth century? All of this suggests that these commodity frontiers were increasingly occupying and producing the same 'place' of the world-ecology, even as this place was quite evidently transformed by distinctive socio-ecological conditions and specific regional contexts. The patterns of boom and bust were still loosely, and yet increasingly, teleconnected through the circuits of capital and the machinery of empire.

What kind of capitalism was this? There is a strong current in Marxist thought (and not only Marxist thought) that views early capitalism as little more than a proving ground for the 'real' capitalism that emerged in the nineteenth century (e.g. Wolf 1982; Fox-Genovese and Genovese 1983). It is a view with definite implications for our analysis of the present socio-ecological *conjuncture*, which we see in the recent flourishing of critical enquiries swirling around peak oil and 'fossil capitalism' (e.g. Altvater 2007). My position is different. Early capitalism was indeed *real* capitalism. Early modern capitalism's ecological regime was one premised on a highly effective combination of military conquest, the vigorous geographical extension of commodity production directly (as in the plantation system) and indirectly (as in Poland's agro-export expansion), the creation of financial structures that radically accelerated turnover time and sustained economic interdependence on a globalizing basis, and the maximization of technological development oriented towards geographical expansion. Early capitalism was based on a globalizing ecological strategy that emphasized the radical expansion of the arena for commodity production and market exchange.

Hence the centrality of the commodity *frontier*: this we have seen with timber, naval stores, cereals, metals and fisheries in the North Atlantic and, in Part I, with silver mining in the South Atlantic, and the 'battle for wood' in Spain. One could follow similar stories regarding stock raising, sugar planting, tobacco cultivation, fur trapping, slaving and other commodity frontiers across the geographical expanse of early capitalism. This was, above all, a *commodity-widening* strategy. There were, in the Low Countries and then England, important moves towards rising agricultural productivity. The story of agricultural revolutions in these regions might be understood as moments of *commodity-deepening*, and this had important implications for the course of capitalist geographical expansion, as with the relation between Poland and the Low Countries. On balance, however, between 1450 and 1750 there was clearly more widening than there was deepening in the European world-economy. By the later eighteenth century, however, English industrialization was beginning to reverse the earlier state of affairs. The arena of commodity-deepening had shifted from agriculture to industry. The problem was, by the 1750s English agriculture was no longer revolutionary. The sustained productivity increases of the seventeenth century had given way to relative stagnation. After 130 years of low cereal prices throughout Europe, Britain's rose by 40 per cent between 1760 and 1790, an especially dramatic reversal for a region that had displaced the Baltic as Europe's leading grain exporter after 1700 (Bairoch 1973, 459; Pomeranz 2000, 217). Agricultural prices *trebled*, compared to just 50 per cent for industrial prices, between 1745 and 1815 (O'Brien 1985, 776).

This was expressive of two great movements. Firstly, it revealed a system-wide exhaustion of early capitalism *as* ecological regime. This regime was capitalist enough in *breadth*, but by the 1760s, it was no longer capitalist enough in *depth*.

Secondly, it indicated a looming agro-ecological bottleneck that threatened the middle-run prospects of British-led industrialization. This bottleneck would not be overcome through innovation alone but, rather, through the dynamic combination of plunder and productivity, of global expansion and socio-technical innovation. Even with the arrival of England's 'second agricultural revolution' after 1815 (Thompson 1968) – achieving full flower with the global sourcing strategies of guano and oilseed imports – the agro-ecological responses to the conjuncture of the later eighteenth century represented a new weave of the basic pattern that took shape after 1550. Like the Dutch before them, the British would farm out the provisioning of cereals to the frontier – above all, to North America after 1846. 'Fossil capitalism' did not extinguish the need for the great frontier. It amplified it.

The interpretive argument unfolds in conversation with the paradigmatic argument. I have argued for 'environmental history *as*' rather than 'environmental history *of*'. This means rethinking the rise of the Global North Atlantic after 1550, and Dutch hegemony in particular, as *ecological process and project* – world-historical movements that aimed at reconfiguring nature–society relations within and across overlapping geographical arenas of commodity production, exchange and extraction. This entails more than a catalogue of early capitalism's biophysical depredations. It calls for a paradigmatic transition that seeks to bridge the divide between the 'social theory of the environment' on the one hand, and the 'theory of social change' on the other. My choice of language is deliberate: 'ecological project' does not refer to an ensemble of intended and unintended *environmental* consequences issuing from the social agencies of state, market and class. Rather, the signifier 'ecology' (and its cognates such as ecological regime), refers to a holistic perspective on the society–environment relation in a way very close to how the philosopher–botanist Theophrastus deployed the Greek word *oikeios*: 'to indicate the *relationship* between a plant species and the environment' (Hughes 1994, 4, emphasis added). The relations are at the centre. If organism and environment constitute the parts, *ecology* signifies the whole that emerges through these relations. I have offered, then, partly a new interpretation of the place of environmental history in the making of an increasingly capitalist North Atlantic. But at its core, what is at stake is how we *think* capitalism, or if you prefer, modernity, colonialism and the many other possible 'master processes' of world-historical change (Tilly 1984). The alternative is between differing ways of seeing – between a capitalism that acts *upon* nature, and one that develops *through* nature. We have, I believe, arrived at a powerful eductive moment – one that allows us to erase old boundaries and open new vistas, one where we can rethink capitalism on the historical basis of the nature–society relation. It is an argument bursting with implications for the present global conjuncture.

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